

ESP 121: Lab 1

Exponential growth

All labs will use the programming language R accessed with the Rstudio interface. Both programs are available for Windows, Mac, and Unix platforms for free from <http://www.r-project.org/> and <http://www.rstudio.com>, and they are installed in all of the on-campus open-access labs (102 Wellman, 182 Shields, 78 Hutchison, and 2101 SCC; see <http://clm.ucdavis.edu/rooms/available/> for available hours).

The goal of the labs is to gain a greater intuition of the models covered in class through numerical exploration. In other words, this is where you get a chance to plug numbers in, as compared to the analytical (i.e., symbolic) exploration in lecture. These two approaches are complementary: analytical exploration is crucial to giving a sense of how a model behaves under all cases and *why*, and therefore provides broader insight. Numerical exploration provides insight into specific cases and, as such, can provide more concrete and accessible understanding.

This lab will use the script `exprn0.R`, which plots exponential growth $n(t) = n_0 e^{rt}$, the solution to $\frac{dn}{dt} = rn$, for two different populations with different values of r and n_0 . Open `exprn0.R` and run (select all, copy, paste at the prompt, and hit enter). Your tasks for this lab are:

1. Comparing changing values of the growth rate r versus changing the initial population size n_0 : first keep the n_0 values the same for the two populations and select different values for r , then set the r values to be the same (the lower of the values you just used) and set different values for n_0 . For both comparisons, only choose positive values for r . A good idea here for comparison is to try keeping the proportional change the same, e.g. one value is double the other in both cases. Pay close attention to the y-axis values (if you see `e+X` it means $\times 10^X$). Which has a greater effect on the population trajectory, r or n_0 ? Why do you think this is?
2. Comparing population change across countries: go to <http://www.indexmundi.com/g/r.aspx?t=0&v=24> which provides population growth rates across countries. Note that these numbers are percentage changes per year accounting for births, deaths, immigration, and emigration.
 - (a) Chose two different countries from the list to compare. First set r_1 and r_2 to their population growth rates. You will need to convert the percentages from the website into rates: at the prompt in R enter `rconvert(#)` for the numbers you find on the website, and use the output numbers in the sliders for the plot. Then select “Demographics: population” from the drop-down menu on the website, and set n_{01} and n_{02} to the population size values for the same two countries (as close as you can, it won’t be exact). Report the countries and values you used and describe the differences between the curves over the course of 50 years.
 - (b) Note that your comparison in part (a) assumes that the populations in both countries will continue to follow the exponential growth model for the next 50 years. Is this a good assumption for the countries you chose? Why or why not?